

Accumulator Data Stream
 $G_n = G_{n-1} + 0.6875 - \text{INT}(G_{n-1})$ $R_n = \text{INT}(G_n)$

0.6875	0
1.375	1
1.0625	1
0.75	0
1.4375	1
1.125	1
0.8125	0
1.5	1
1.1875	1
0.875	0
1.5625	1
1.25	1
0.9375	0
1.625	1
1.3125	1
1	1
0.6875	0

FIG. 2

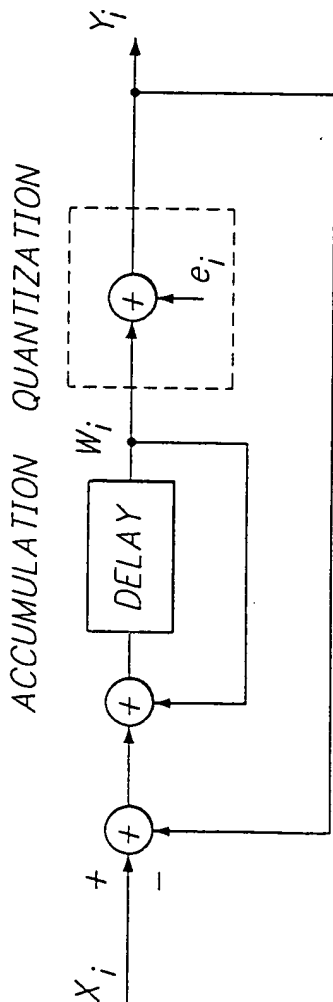


FIG. 1

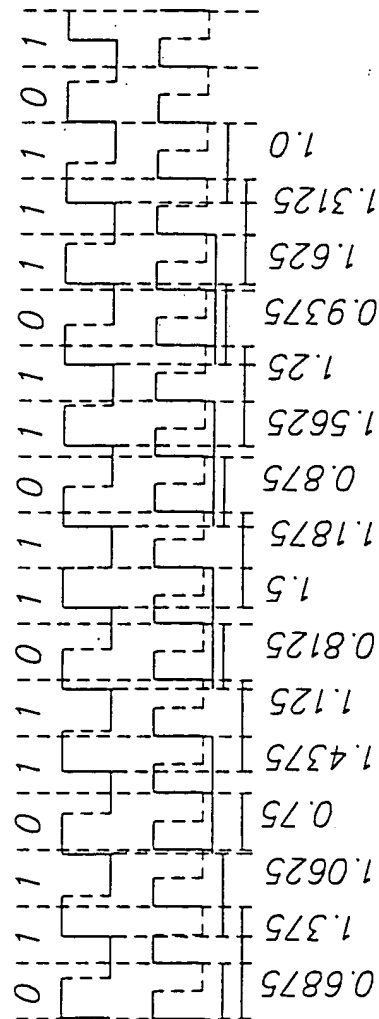


FIG. 3

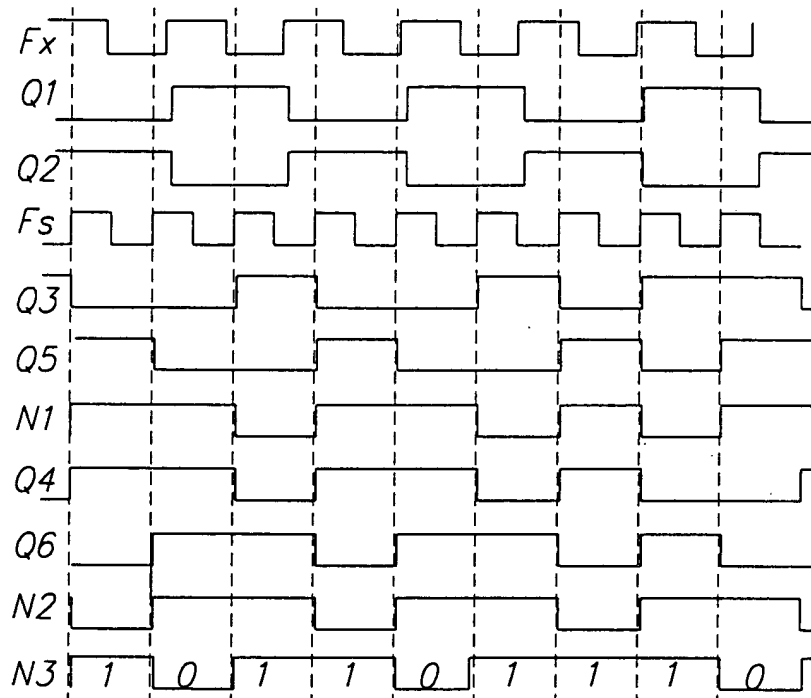


FIG. 5

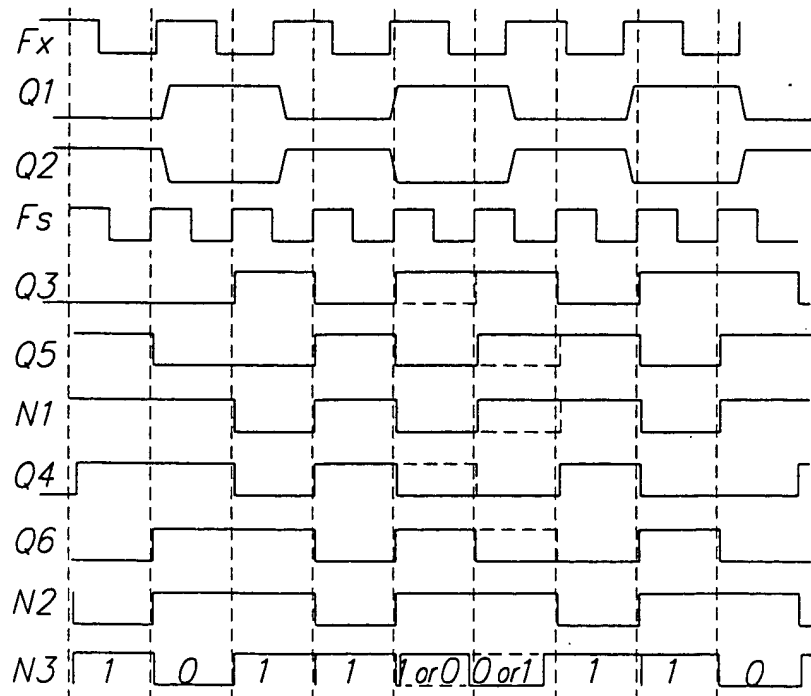


FIG. 6

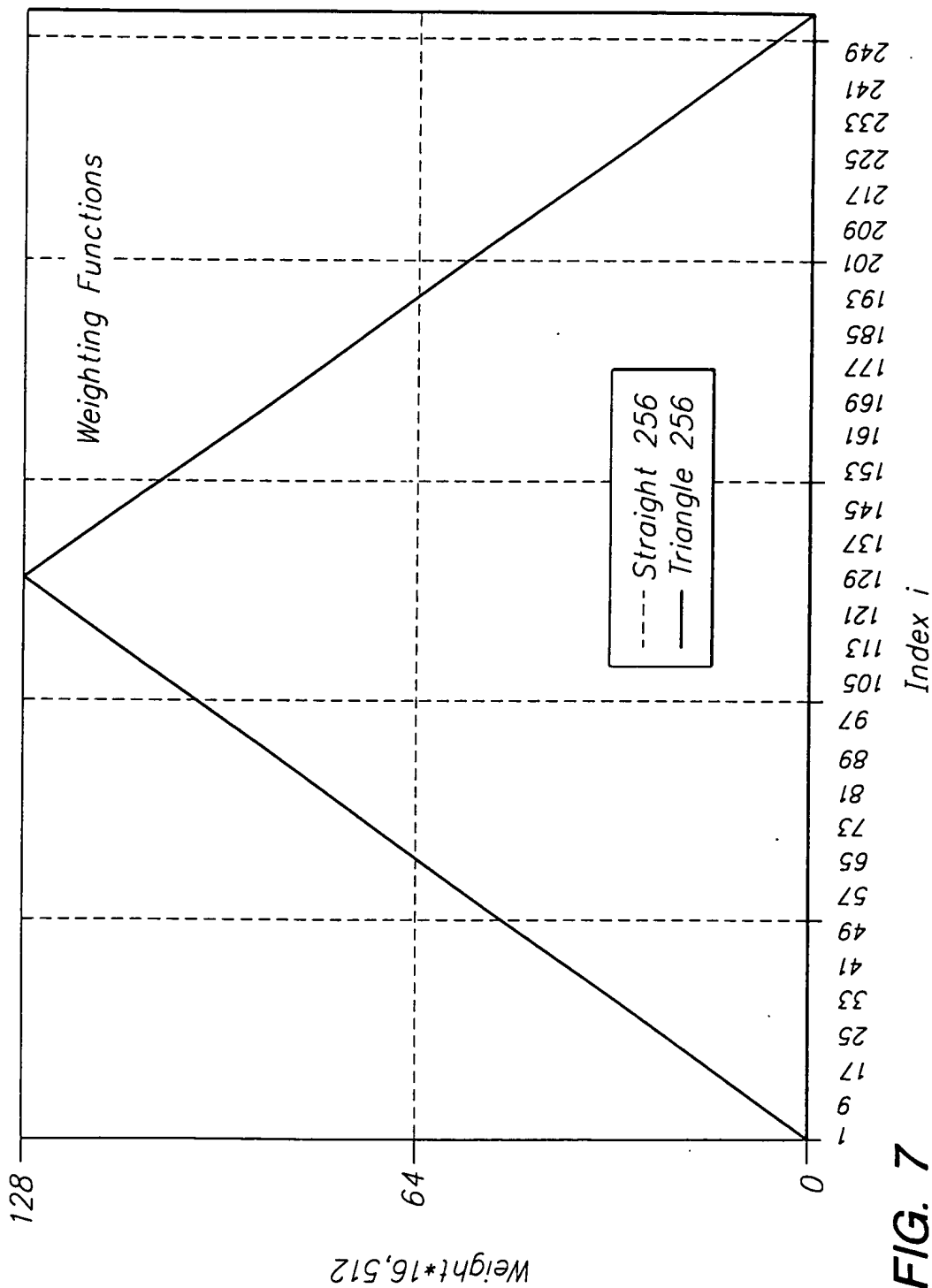


FIG. 7

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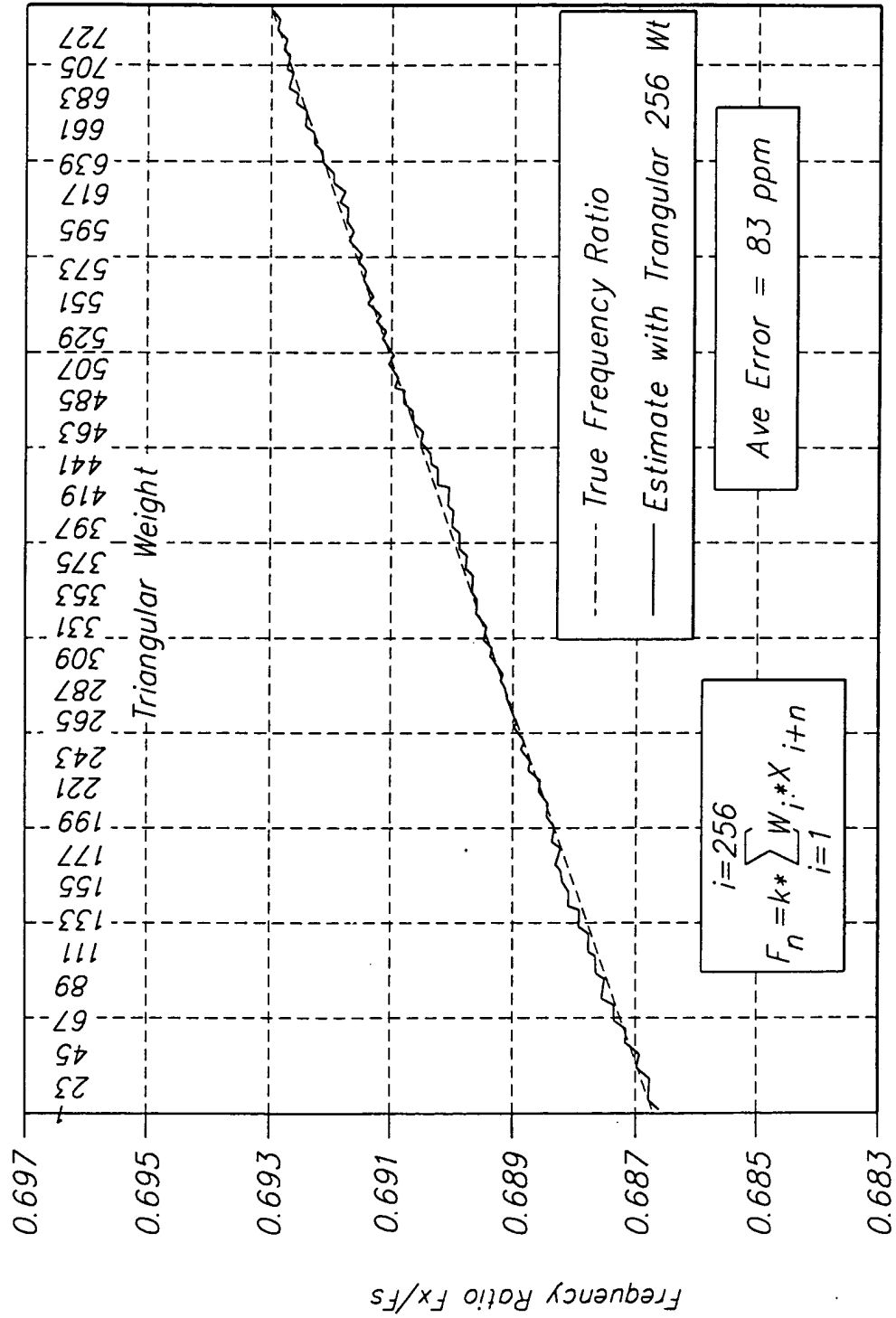


FIG. 9

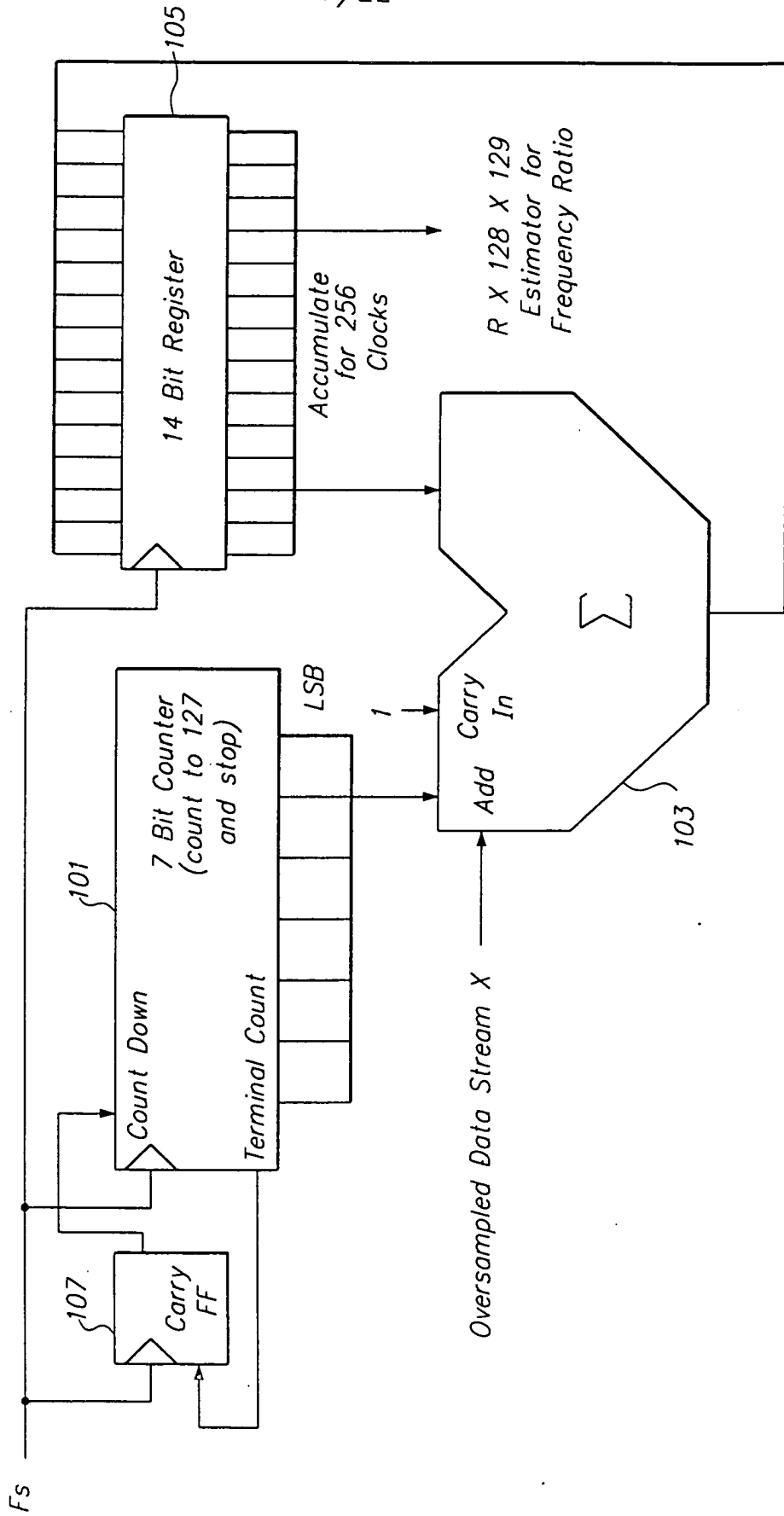


FIG. 10

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FIG. 11A-1

Observed Frequency Data Stream <i>X</i>	Weight <i>W</i>	<i>Fr</i> Ratio = Reference Frequency/ Sample Frequency =
1	1	0.6875
1	2	
0	3	
1	4	
1	5	
0	6	
1	7	
1	8	
0	9	
1	10	
1	11	
1	12	
0	13	
1	14	
1	15	
0	16	
1	17	
1	18	
0	19	
1	20	
1	21	
0	22	
1	23	
1	24	
0	25	
1	26	
1	27	
1	28	
0	29	
1	30	
1	31	
0	32	
1	33	
1	34	
0	35	
1	36	
1	37	
0	38	
1	39	
1	40	
0	41	
1	42	
1	43	

FIG. 11A-1

FIG. 11A-2

FIG. 11A

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0	44				
1	45				
1	46				
1	47				
0	48				
1	49				
1	50				
0	51				
1	52				
1	53				
0	54				
1	55				
1	56				
0	57				
1	58				
1	59				
0	60				
1	61				
1	62				
1	63				
0	64				
1	64				
1	63				
0	62				
1	61				
1	60				
0	59				
1	58				

		Frequency Estimate		Integration	
		Correct Phase	$F_n =$ $\sum_i (W_i * X_{i+n})$ F	$\Delta F_i =$ $F_i - F_{r-1}$ Ratio ΔF	$PF_n =$ $PF_{n-1} * k * \Delta F_i$ Pf
1	64	-53.714763	0.686058	-0.001442	-55.876923
1	63	-54.394811	0.686058	-0.001442	-56.615385
0	62	-55.066978	0.686058	-0.001442	-57.353846
1	61	-55.731139	0.686058	-0.001442	-58.092308
1	60	-56.387171	0.686058	-0.001442	-58.830769
0	59	-57.034949	0.686058	-0.001442	-59.569231
1	58	-57.674350	0.686058	-0.001442	-60.307692

FIG. 11A-2

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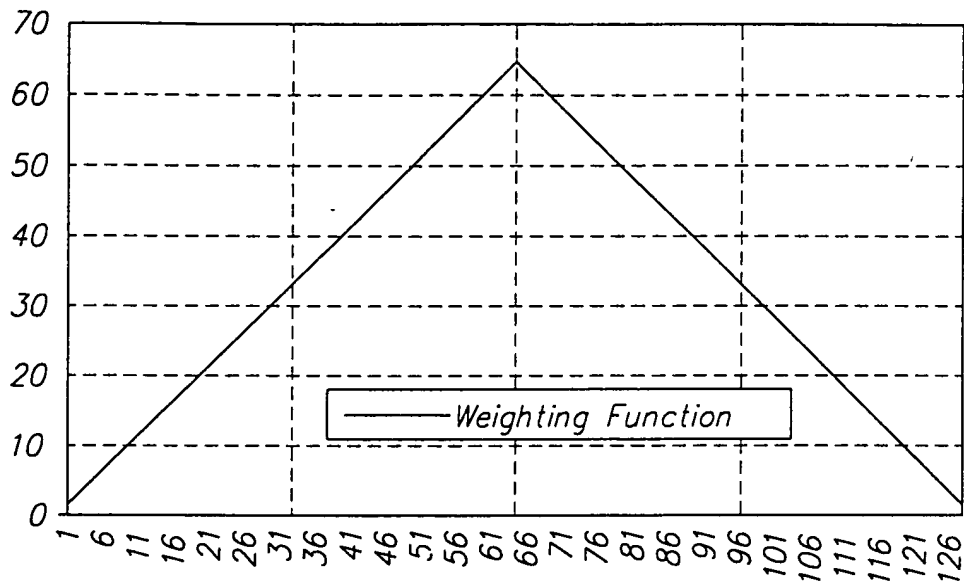
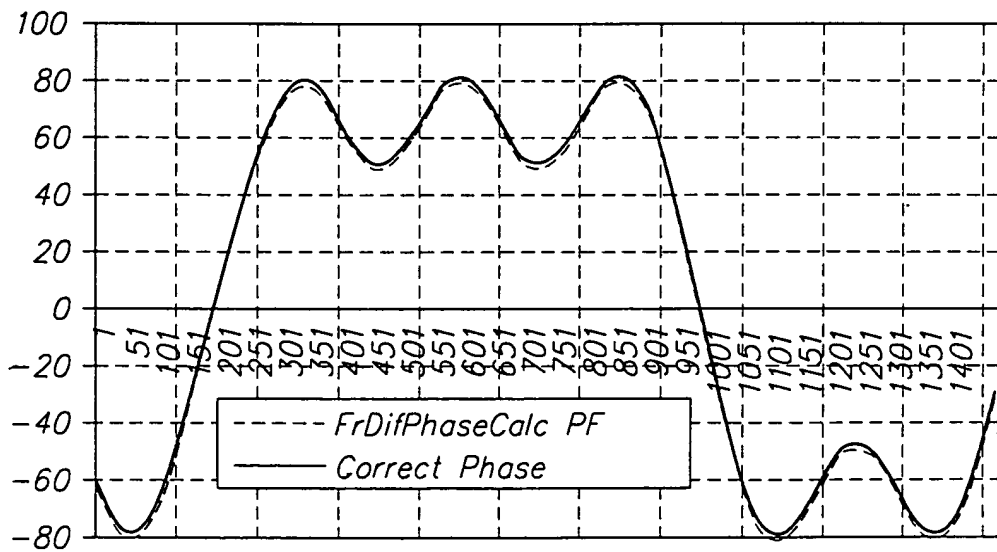


FIG. 11B



Ave Error=1.501453

FIG. 11C

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Observed Frequency Data Stream X	Weight W	$Y_i = X_i - FrRatio$ Y	$PX_i = PX_{i-1} + Y_i$ P_x	$Fr Ratio =$ Reference Frequency/ Sample Frequency = 0.6875
1	1	0.3125	0.0000	
1	2	0.3125	0.3125	
0	3	-0.6875	-0.3750	
1	4	0.3125	-0.0625	
1	5	0.3125	0.2500	
0	6	-0.6875	-0.4375	
1	7	0.3125	-0.1250	
1	8	0.3125	0.1875	
0	9	-0.6875	-0.5000	
1	10	0.3125	-0.1875	
1	11	0.3125	0.1250	
1	12	0.3125	0.4375	
0	13	-0.6875	-0.2500	
1	14	0.3125	0.0625	
1	15	0.3125	0.3750	
0	16	-0.6875	-0.3125	
1	17	0.3125	0.0000	
1	18	0.3125	0.3125	
0	19	-0.6875	-0.3750	
1	20	0.3125	-0.0625	
1	21	0.3125	0.2500	
0	22	-0.6875	-0.4375	
1	23	0.3125	-0.1250	
1	24	0.3125	0.1875	
0	25	-0.6875	-0.5000	
1	26	0.3125	-0.1875	
1	27	0.3125	0.1250	
1	28	0.3125	0.4375	
0	29	-0.6875	-0.2500	
1	30	0.3125	0.0625	
1	31	0.3125	0.3750	
0	32	-0.6875	-0.3125	
1	33	0.3125	0.0000	
1	34	0.3125	0.3125	
0	35	-0.6875	-0.3750	
1	36	0.3125	-0.0625	
1	37	0.3125	0.2500	
0	38	-0.6875	-0.4375	
1	39	0.3125	-0.1250	
1	40	0.3125	0.1875	
0	41	-0.6875	-0.5000	
1	42	0.3125	-0.1875	
1	43	0.3125	0.1250	

FIG. 12A-1

FIG. 12A-1

FIG. 12A-2

FIG. 12A

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0	44	-0.6875	-0.5625		
1	45	0.3125	-0.2500		
1	46	0.3125	0.0625		
1	47	0.3125	0.3750		
0	48	-0.6875	-0.3125		
1	49	0.3125	0.0000		
1	50	0.3125	0.3125		
0	51	-0.6875	-0.3750		
1	52	0.3125	-0.0625		
1	53	0.3125	0.2500		
0	54	-0.6875	-0.4375		
1	55	0.3125	-0.1250		
1	56	0.3125	0.1875		
0	57	-0.6875	-0.5000		
1	58	0.3125	-0.1875		
1	59	0.3125	0.1250		
0	60	-0.6875	-0.5625		
1	61	0.3125	-0.2500		
1	62	0.3125	0.0625		
1	63	0.3125	0.3750		
0	64	-0.6875	-0.3125		
1	64	0.3125	0.0000	-53.714763	-55.876923
1	63	0.3125	0.3125	-54.394811	-56.615385
0	62	-0.6875	-0.3750	-55.066976	-57.353846
1	61	0.3125	-0.0625	-55.731139	-58.092308
1	60	0.3125	0.2500	-56.387171	-58.830769
0	59	-0.6875	-0.4376	-57.034949	-59.569231
1	58	0.3125	-0.1250	-57.674350	-60.307692

Correct
Phase

$$PP_n = \frac{k \sum_i (W_i + PX_{i+n})}{PP}$$

FIG. 12A-2

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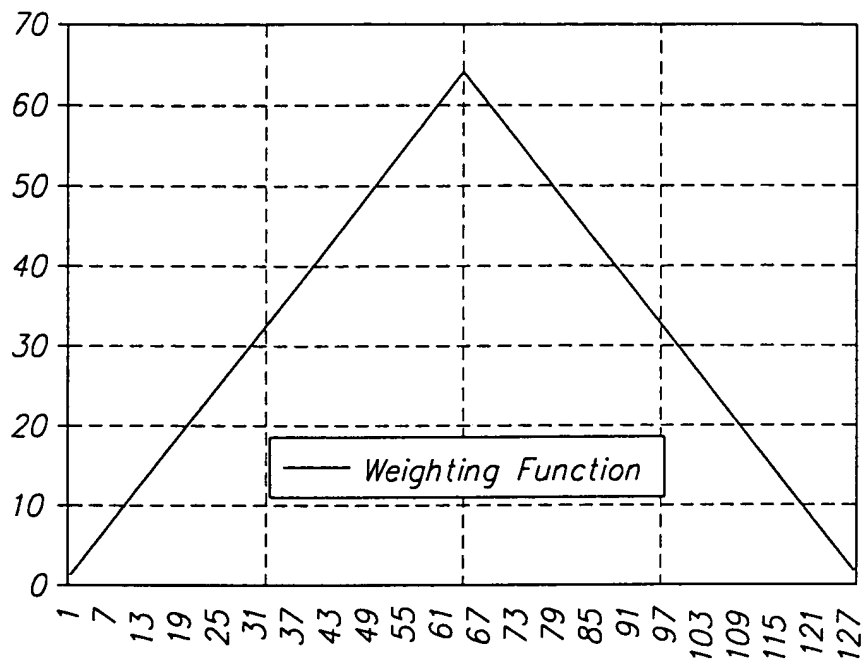
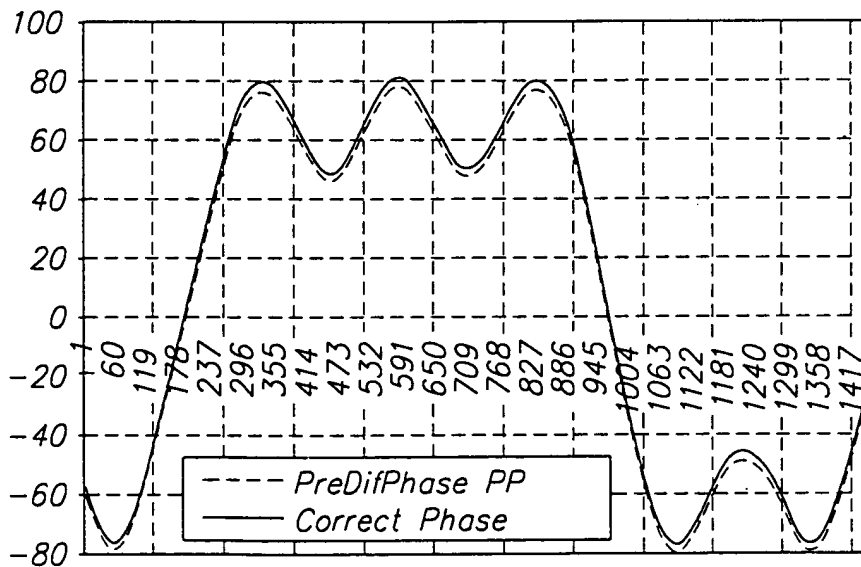


FIG. 12B



Ave Error= 1.501453

FIG. 12C

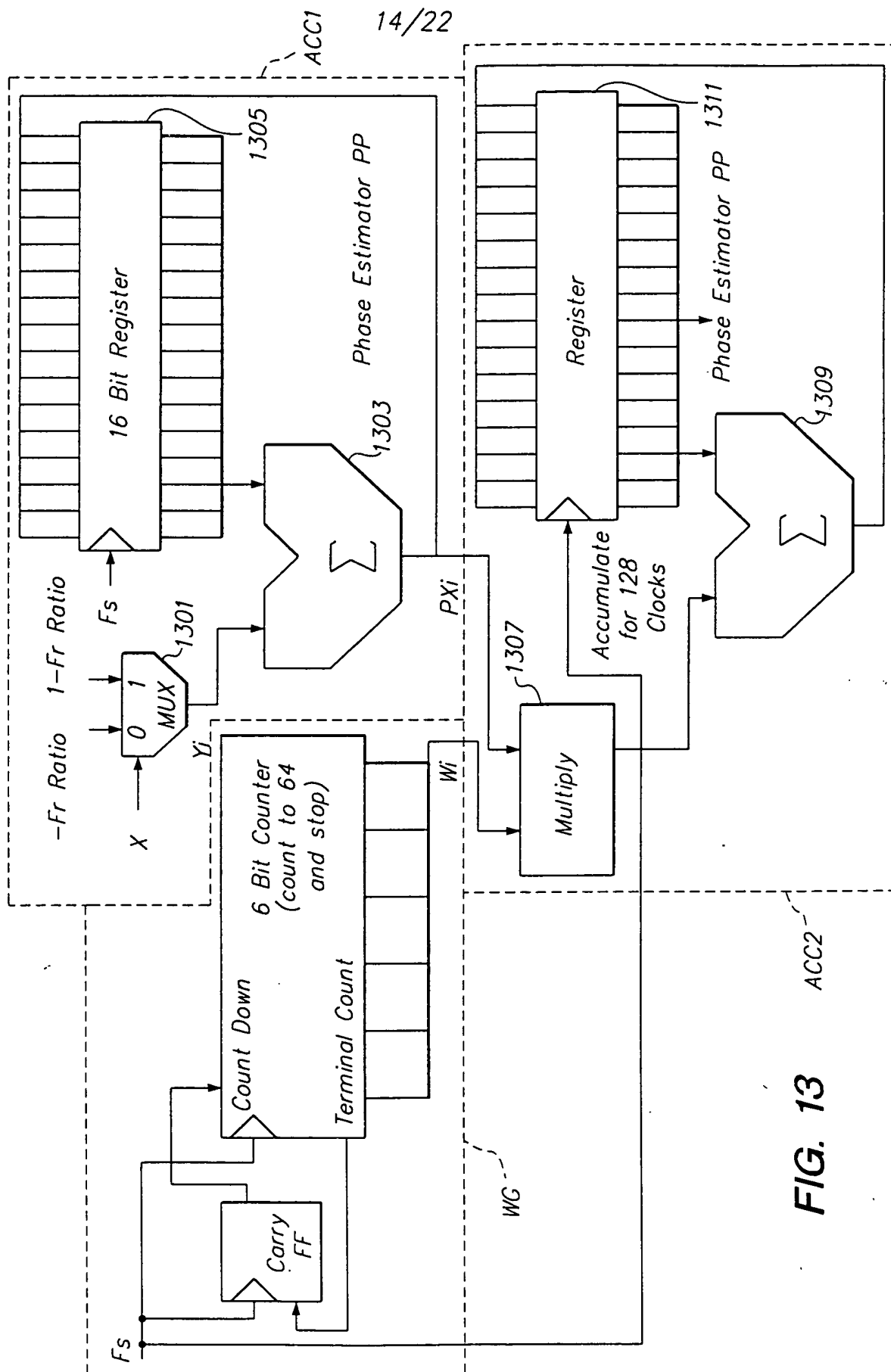


FIG. 13

Reference Frequency Data Stream R	Observed Frequency Data System X	$D_i =$ $D_{i-1} + X_i - R_i$ D	Weight W	$Fr \text{ Ratio} =$ Reference Frequency/ Sample Frequency = 0.6875
1	1	0	1	
1	1	0	2	
0	0	0	3	
1	1	0	4	
1	1	0	5	
0	0	0	6	
1	1	0	7	
1	1	0	8	
1	0	-1	9	
0	1	0	10	
1	1	0	11	
1	1	0	12	
0	0	0	13	
1	1	0	14	
1	1	0	15	
0	0	0	16	
1	1	0	17	
1	1	0	18	
0	0	0	19	
1	1	0	20	
1	1	0	21	
0	0	0	22	
1	1	0	23	
1	1	0	24	
1	0	-1	25	
0	1	0	26	
1	1	0	27	
1	1	0	28	
0	0	0	29	
1	1	0	30	
1	1	0	31	
0	0	0	32	
1	1	0	33	
1	1	0	34	
0	0	0	35	
1	1	0	36	
1	1	0	37	
0	0	0	38	
1	1	0	39	
1	1	0	40	
1	0	-1	41	
0	1	0	42	

FIG. 14A-1

FIG. 14A-1

FIG. 14A-2

FIG. 14A

1	1	0	43		
1	0	-1	44		
0	1	0	45		
1	1	0	46		
1	1	0	47		
0	0	0	48		
1	1	0	49		
1	1	0	50		
0	0	0	51		
1	1	0	52		
1	1	0	53		
0	0	0	54		
1	1	0	55		
1	1	0	56		
1	0	-1	57		
0	1	0	58		
1	1	0	59		
1	0	-1	60		
0	1	0	61		
1	1	0	62		
1	1	0	63		
0	0	0	64		
1	1	0	64		
1	1	0	63		
0	0	0	62		
1	1	0	61		
1	1	0	60		
0	0	0	59		
1	1	0	58		
				$k_0 = 16$	
				Correct Phase	$PI_n =$ $k_0 + k_1 * \sum_i (W_i * D_{i+n})$ F
				-53.714763	-55.876923
				-54.394811	-56.615385
				-55.066978	-57.353846
				-55.731139	-58.092308
				-56.387171	-58.830769
				-57.034949	-59.569231
				-57.674350	-60.307692

FIG. 14A-2

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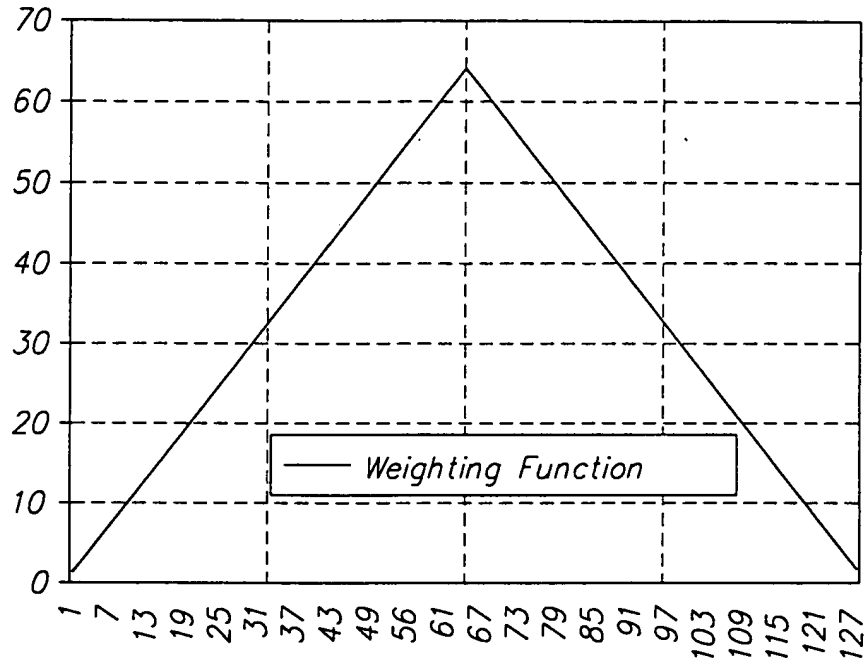
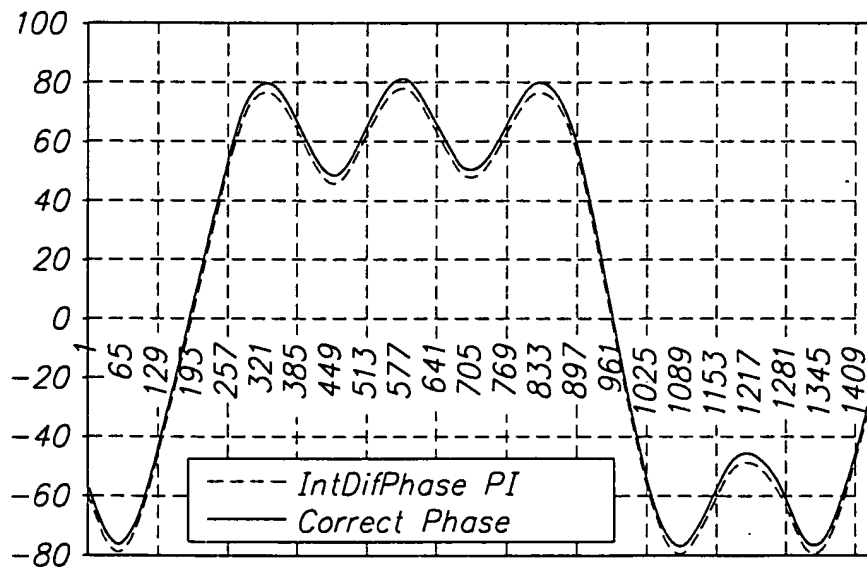


FIG. 14B



Ave Error= 1.501453

FIG. 14C

Reference Frequency Generator RG	Reference Frequency Data Stream R	Observed Frequency Data System X	$D_i =$ $D_{i-1} + X_i - R_i$ D	Weight W	Fr Ratio= Reference Frequency/ Sample Frequency = 0.6875
1.5	1	1	0	-0.5	
1.1875	1	1	0	-2	
0.875	0	0	0	-4.5	
1.5625	1	1	0	-8	
1.25	1	1	0	-12.5	
0.9375	0	0	0	-18	
1.625	1	1	0	-24.5	
1.3125	1	1	0	-32	
1	1	0	-1	-40.5	
0.6675	0	1	0	-50	
1.375	1	1	0	-60.5	
1.0625	1	1	0	-72	
0.75	0	0	0	-84.5	
1.4375	1	1	0	-98	
1.125	1	1	0	-112.5	
0.8125	0	0	0	-128	
1.5	1	1	0	-144.5	
1.1875	1	1	0	-162	
0.875	0	0	0	-180.5	
1.5625	1	1	0	-200	
1.25	1	1	0	-220.5	
0.9375	0	0	0	-242	
1.625	1	1	0	-264.5	
1.3125	1	1	0	-288	
1	1	0	-1	-312.5	
0.6875	0	1	0	-338	
1.375	1	1	0	-364.5	
1.0625	1	1	0	-392	
0.75	0	0	0	-420.5	
1.4375	1	1	0	-450	
1.125	1	1	0	-480.5	
0.8125	0	0	0	-512	
1.5	1	1	0	-644.5	
1.1875	1	1	0	-578	
0.875	0	0	0	-612.5	
1.5625	1	1	0	-648	
1.25	1	1	0	-684.5	
0.9375	0	0	0	-722	
1.625	1	1	0	-760.6	
1.3125	1	1	0	-800	
1	1	0	-1	-840.5	
0.6875	0	1	0	882	

FIG.
16A-1

FIG. 16A-2

FIG. 16A

FIG. 16A-1

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1.375	1	1	0	-924.5
1.0625	1	0	-1	-968
0.75	0	1	0	-1012.5
1.4375	1	1	0	-1068
1.125	1	1	0	-1104.5
0.8125	0	0	0	-1152
1.5	1	1	0	-1200.5
1.1875	1	1	0	-1250
0.875	0	0	0	-1300.5
1.5625	1	1	0	-1352
1.25	1	1	0	-1404.5
0.9375	0	0	0	-1458
1.625	1	1	0	-1512.5
1.3125	1	1	0	-1568
1	1	0	-1	-1624.5
0.6875	0	1	0	-1682
1.375	1	1	0	-1740.5
1.0625	1	0	-1	-1800
0.75	0	1	0	-1860.5
1.4375	1	1	0	-1922
1.125	1	1	0	-1984.5
0.8125	0	0	0	-2048
1.5	1	1	0	2048
1.1875	1	1	0	1984.5
0.875	0	0	0	1922
1.5625	1	1	0	1860.5
1.25	1	1	0	1800
0.9375	0	0	0	1740.5
1.625	1	1	0	1682
1.3125	1	1	0	1624.5

Correct Phase	$PC_n =$ $k \cdot (D_n - \text{frac}(RC_n)) + 0.5 + \sum_i (W_i \cdot X_{i+n-64})$ PC
-53.374738	-55.507692
-54.054787	-56.246154
-54.730895	-56.984615
-55.399059	-57.723077
-56.059155	-58.461538
-56.711060	-59.200000
-57.354650	-59.938462
-57.939800	-60.676923

FIG. 16A-2

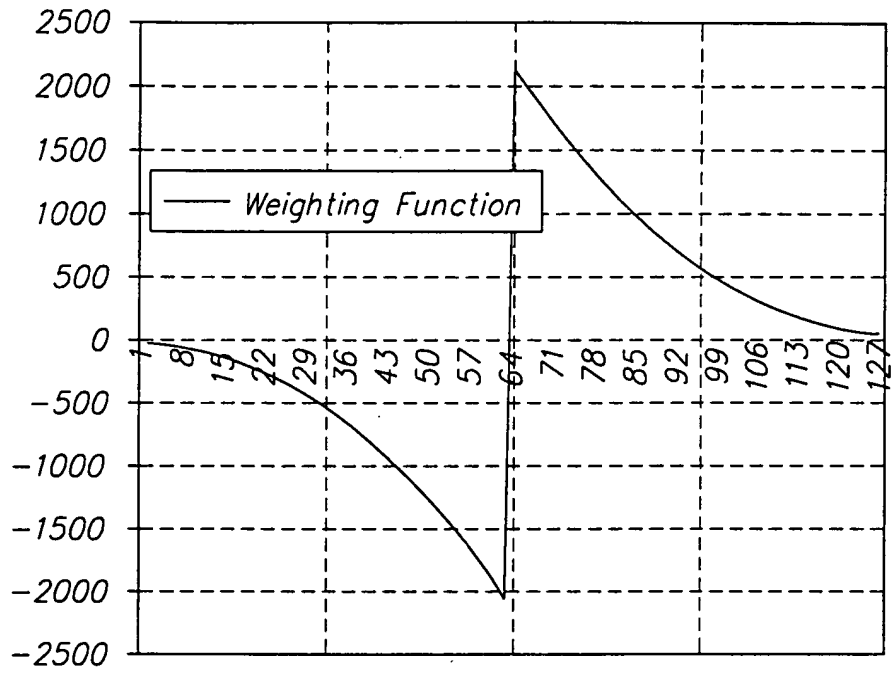
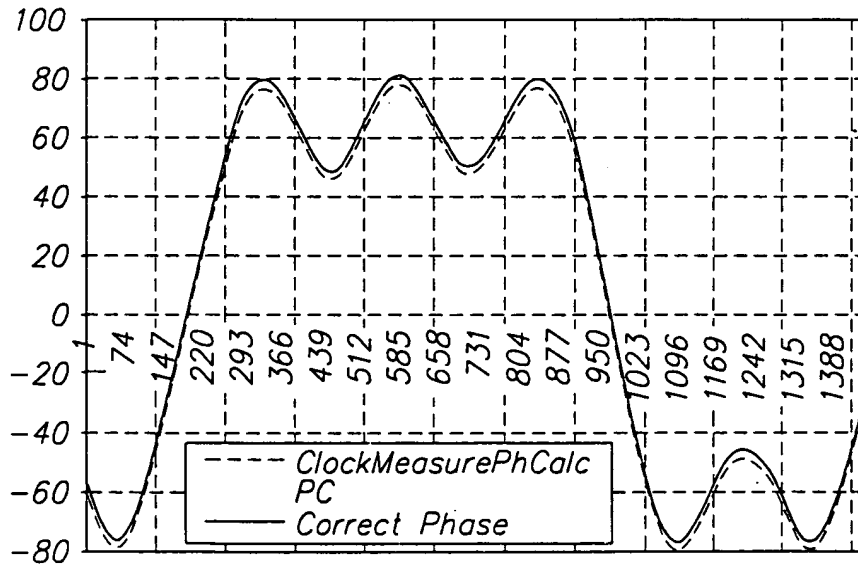


FIG. 16B



Ave Error= 1.501476

FIG. 16C

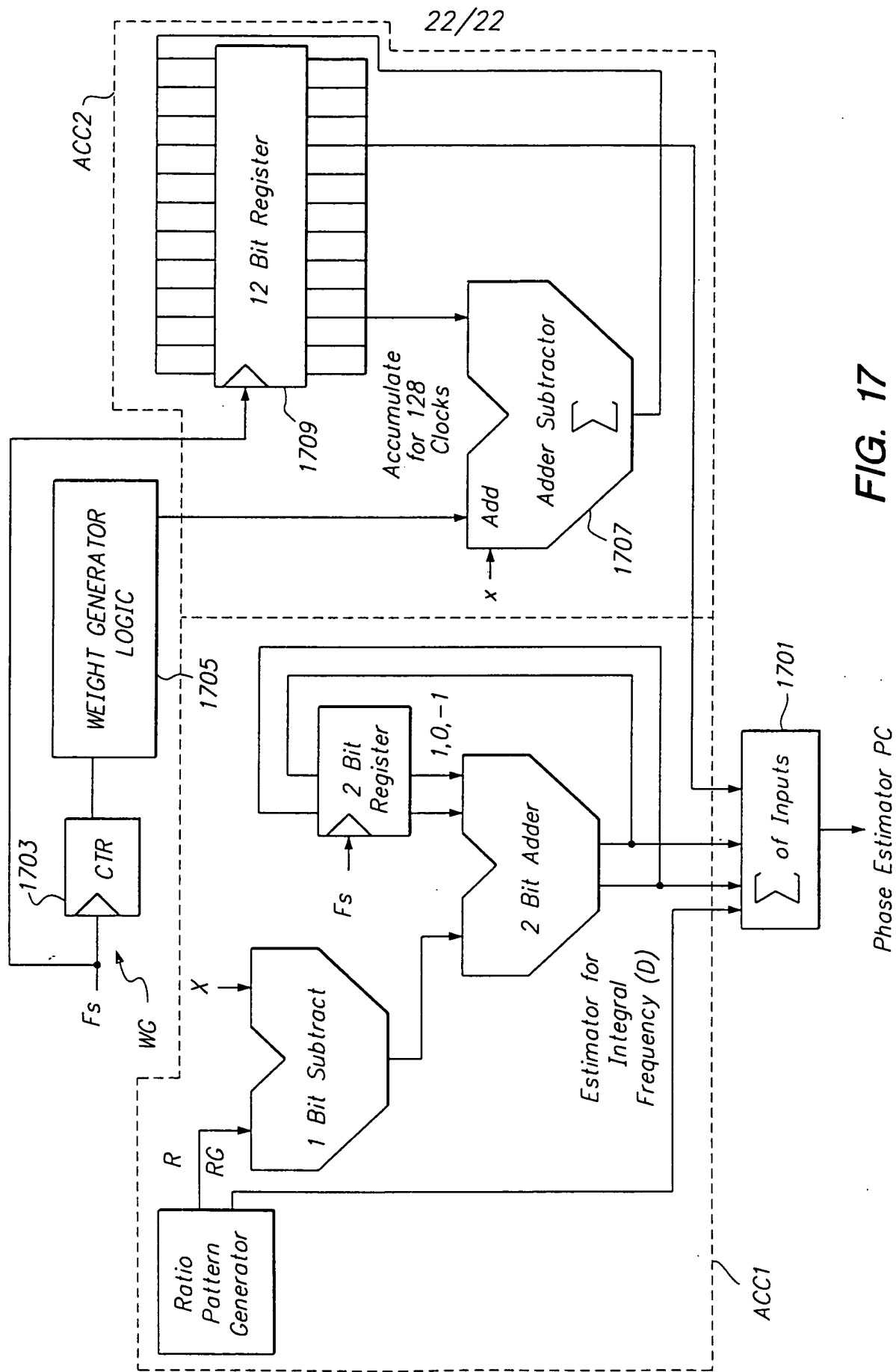


FIG. 17